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Diseases of Garden Crops and Their Control

By N. J. GIDDINGS

[The Bulletins and Reports of this Station will be mailed free to any citizen of West Virginia upon written application. Address Director of Agricultural Experiment Station, Morgantown, W. Va.]

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MAY 18, 1909.

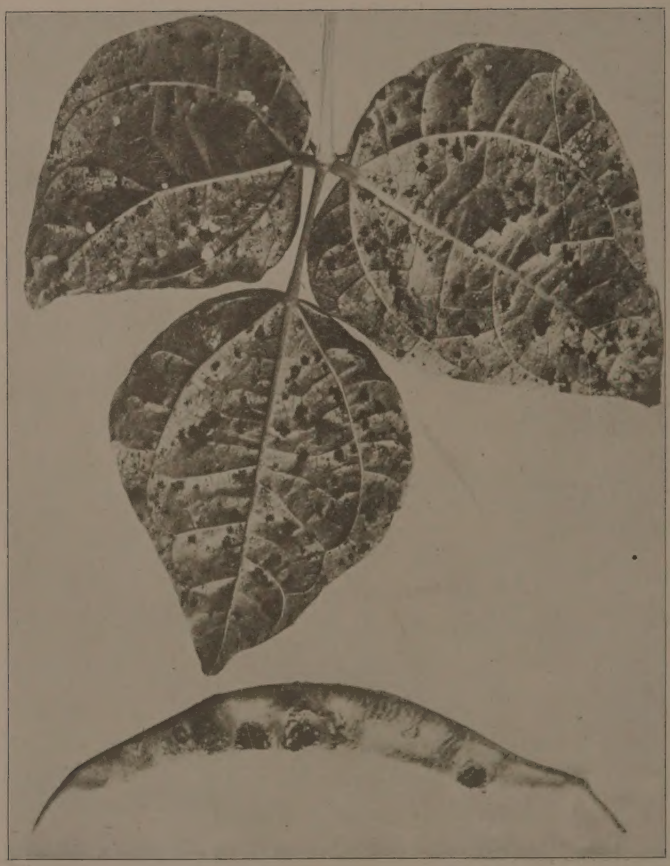
This bulletin, concerning diseases of garden crops and their control, is the fourth of a series of practical bulletins to be issued by this Station from time to time for the promotion of the horticultural and trucking industries of the State. The first bulletin is upon the subject of certain enemies of cabbages and how to destroy them, the second upon apple enemies and how to fight them; and the third on the home garden.

J. H. STEWART, *Director.*

PLATE I

Anthracnose of bean.

PLATE II.



Rust of bean.

Diseases of Garden Crops and Their Control

The diseases of garden crops are numerous and cause large financial losses in many fields every year. It is the aim of this bulletin to give brief general descriptions of some of the more common of these diseases so that they may be recognized, and to outline methods of treatment by which they may be controlled or prevented.

Since bordeaux mixture is the most important material which has yet been discovered for the prevention and control of plant diseases, a few words as to its preparation and use will be given at this time. It should be prepared as follows: Place 5 pounds of good unslaked lime in a barrel, add water slowly until it is all slaked, and then add enough more water to make 25 gallons in all. The mixture should be well stirred all the time while adding the water and must be allowed to cool before mixing with the copper sulphate.

Measure into another barrel 25 gallons of water and add to it 5 pounds of copper sulphate (bluestone). It is best to place the copper sulphate in a piece of coarse cloth such as sacking and let this hang in the barrel so that the sulphate is just below the surface of the water. It dissolves much quicker when suspended in this way than when allowed to lie at the bottom of the barrel. Each barrel should be fitted with a molasses gate about 1½ inches in diameter and should have a short trough leading from this gate to a small tub or box which in turn has a trough leading to the spray tank. The box or tub should be covered with a cheese cloth strainer to keep out lumps.

When the lime mixture has cooled stir it thoroughly and open the gate on both the lime barrel and the copper sulphate barrel. Regulate these gates to have about the same sized stream come from each, and so that both barrels are emptied at

the same time. The materials come together on the strainer forming bordeaux mixture. It is necessary to keep stirring the materials on the strainer with one hand most of the time as the little lumps collect on the cloth and clog it. The lime mixture must be stirred almost constantly while it is running out because it settles very quickly.

If it is desired to use the spray against insect enemies as well as fungus diseases paris green may be added to the mixture at the rate of ½ pound to 50 gallons, or arsenate of lead at the rate of 3 pounds to 50 gallons. The insecticide should be mixed up in a little water before adding to the bordeaux so as to avoid lumps.

There are several other formulae for bordeaux mixture some calling for 4 pounds of lime and 4 pounds of copper sulphate, others for 6 pounds of lime and 4 pounds of copper sulphate to the 50 gallons of water. The amount of lime, however, is always equal to or greater than the amount of copper sulphate, and in any case the proper method of preparation is that described above. The practice of adding strong lime mixture to dilute copper sulphate solution usually gives good results, but the method here outlined is generally acknowledged as better.

Stock solutions are frequently used and save a considerable amount of time and trouble. The best way to make up these solutions is to use 1 pound of material to one gallon of water so that in the case of a stock solution of copper sulphate containing 30 pounds of the sulphate there would be 30 gallons of water. In the same way the lime after being slaked would have water added to it until it contained at the rate of 1 gallon of water to 1 pound of lime. For use 1 gallon of the stock solution would be diluted with 4 gallons of water, and the lime mixture must be thoroughly stirred each time before taking any from the barrel.

When bordeaux mixture is properly prepared, one can hardly apply too much. In case of doubt as to the amount to

use on any crop it is well to apply as much as the leaves will carry without dripping.

There are various appliances for spraying plants, and one must be governed largely in his choice of machine by the amount of spraying to be done. For out-door work the barrel pump is probably the most useful and the most economical for the small grower. When one endeavors to apply bordeaux mixture to an out-door crop in a field of half an acre or more, using a knapsack sprayer, the amount used will seldom be sufficient for good results. The knapsack sprayers, bucket spray-pumps, etc., are designed more for green houses and small gardens or for the use of a strong insecticide solution. Large growers would of course do well to consider the purchase of a power sprayer. One of the greatest difficulties with the power sprayers now on the market is that they do not apply a sufficient amount of bordeaux.

(Other spraying formulae will be found at the end of this article.)

ASPARAGUS. [1]

Rust.—This disease may be recognized by the reddish or black pustules which occur on the stems and branches. It may be avoided to a large extent by planting on soil which is not too dry and by maintaining a high degree of fertility. At the end of the season all affected plants should be burned. No plants should be allowed to mature during the cutting season.

BEAN.

Anthracnóse.—This disease attacks all parts of the bean plant, producing on the pods sunken scab like spots. It is carried over from one season to another in the seed. Hand sorting of the seed, picking out in this way any beans which

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1 The descriptions and methods of treatment given here and on the following pages are those which the writer believes to be the best now known. Suggestions were secured from various sources and frequently from more than one concerning the same disease, so that no specific acknowledgements are considered necessary.

show signs of the disease, is not recommended, but by selecting *pods* free from diseased spots and using seed from these, good results may be secured. In many cases large growers have found it profitable to spray with bordeaux mixture. All diseased plants should be collected and burned after harvesting the crop.

Rust.—The rust spots appear on the leaves, and occasionally on the pods, as brown powdery masses. The best method of controlling this trouble is to burn all diseased plants after harvesting the crop.

Blight.—The blight is a bacterial disease producing large dead spots in the leaves and sometimes forming depressed watery spots on the pod. This disease is carried over in the seed, so that care should be taken to secure healthy seed. Spraying with the bordeaux mixture is said to reduce the injury.

BEET.

Leaf Spot.—The fungus causing this disease produces on the leaves numerous spots having a purple border and a gray center. It may be controlled by spraying with bordeaux mixture at intervals of about two weeks.

BLACKBERRY AND RASPBERRY.

Rust.—The rust is readily recognized by large orange colored spots on the leaves. These spots are usually on the under side. The fungus lives over from year to year in the canes so that all diseased plants should be taken out and burned.

Anthracnose.—This disease is frequently quite destructive. It produces small gray scab like spots on the canes. All diseased canes should be removed and burned. Spraying with bordeaux mixture will help to prevent it, but ordinarily this would not pay.

CABBAGE CAULIFLOWER AND TURNIP.

Club Root.—This disease is well known from the peculiar irregular enlargement of the roots. A field in which the

PLATE III.

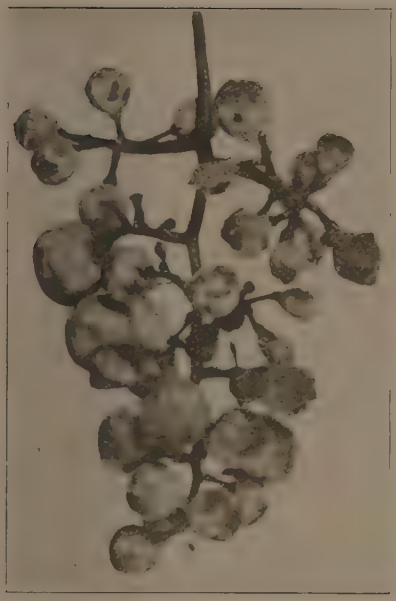

Fig. 1. Downy mildew of grape. After Freeman.

Fig. 2 Black rot of grape.

disease has been present should not be planted to cabbages for several years, and should be kept free from kale, wild turnip, etc., as the fungus lives upon these plants. If it is impossible to avoid planting in an infected field, the ground should be limed at the rate of 50 to 75 bushels per acre. The seedlings should certainly be started in uninfected soil and if such cannot be secured in any other way, the soil may be well baked or steamed before using.

Black Rot.—This is a bacterial disease which is frequently carried on the seed. It is well to disinfect the seed by soaking them in formalin at the rate of 1 pint of formalin to 20 gallons of water, or in corrosive sublimate solution made up at the rate of 1 ounce of corrosive sublimate to 7 gallons of water. Seed should be soaked about 15 minutes.

CELERY.

Blight.—The blight appears on the celery plants as brown spots. When the disease appears early in the season, it may best be controlled by spraying with bordeaux mixture, but for the later sprayings, or in case it does not appear until late in the season, ammonical copper carbonate should be used as this will not stain the plants.

CORN.

Smut.—The large black swellings which this disease produces on corn stalks and ears are found in almost any corn field. The amount of damage done is seldom great but it may be lessened by destroying all diseased stalks and ears before they break open.

CRANBERRY.

Scald, Rot, or Red Rust.—This disease is most prominent and does its most serious damage on the berry. It produces small watery spots which rapidly spread until the whole berry becomes soft. On the leaves it produces irregular reddish brown

spots. In controlling this it is important to destroy all diseased vines in order to prevent its spread. The regulation of water supply is also an important factor, and it is advised to keep the water at such a level that the surface of the bog will be continually moist but not wet. Spraying with bordeaux mixture has not been found very satisfactory.

CUCUMBER.

Anthracnose.—This appears as brownish spots on the leaves, and occasionally causes a rot of the young cucumbers. It may be largely controlled by spraying wih bordeaux mixture.

Mildew.—The fungus causing this disease produces angular yellowish spots on the leaves. In many sections of the country this is a very serious trouble and the station would be especially glad to receive specimens from anyone who suspects the disease in his field. It may be quite well controlled by spraying with bordeaux. The first spraying should be given when plants begin to run and it should be repeated about once in two weeks.

Wilt.—This is a bacterial disease causing the leaves of the plant to wilt and die. The best method of controlling this disease is to destroy or drive away all beetles, since they carry it from plant to plant. The bordeaux mixture is quite good to keep them off the vines.

CURRANT.

Leaf Spot.—There are several fungi which cause the spotting of currant leaves. This frequently results in a yellowing of the leaves and their premature death. In case the disease is quite severe, it might pay to spray with bordeaux mixture.

Cane Blight. Plants attacked by this disease die suddenly. The bark is killed in places and the wood discolored. The best method of treatment is to take all diseased plants from the field and destroy them.

EGG PLANT.

Anthracnose.—This disease attacks the fruit, producing pits of various sizes. When serious, it may be controlled by spraying with bordeaux mixture, or with ammoniacal copper carbonate.

Leaf Spots.—This may be recognized by the brown spots which occur on the leaves. Spraying with bordeaux mixture is advisable for the control of this disease. Plants should not be grown on ground where the disease has occurred the previous year.

GOOSEBERRY.

Mildew.—A grayish white growth occurs on the fruit and leaves of diseased plants. This disease is very destructive upon some varieties. It may be largely controlled by setting the plants where there will be good circulation of air and cutting out the lower drooping branches. Spraying with potassium sulphide about once in 10 days from the time the buds open until the fruit is gathered is quite effective in controlling it.

GRAPE.

Black Rot.—This frequently causes quite severe losses in the grape crop. It produces small brown spots on the leaves, but is most serious upon the fruit, where it appears as small decayed spots which spread rapidly until the entire grape is discolored and shrunken. These shrunken or "mummied" grapes carry the disease over from one year to the next and care should be taken to carefully gather and destroy all such. Wet weather, or grass or weeds around the vines favors the development and spread of this disease, so that clean cultivation should be practiced if possible. Thorough spraying with bordeaux mixture will do much to prevent its development and spread. For late spraying, when the fruit begins to ripen, the ammoniacal copper carbonate is best, since it does not stain the fruit.

Anthracnose.—This disease produces brown spots on the leaves or stems, or, in case the fruit is attacked, scabs with bright colored borders. It may be readily controlled by thorough spraying with bordeaux mixture.

Downy Mildew.—Leaves attacked by this show first lighter green and then yellow spots above, while underneath there are white downy patches. It also attacks the fruits, covering them with a whitish growth and stopping their development. It may be controlled in the same manner as the black rot.

LETTUCE.

Drop or Rot.—This disease is more apt to occur in the greenhouse than out of doors and is not generally noticed until the plants suddenly wilt. It is easily controlled by steam sterilizing the soil to a depth of 2 or 3 inches a short time before planting. If it is not possible to do this, fresh soil should be used.

MUSKMELON.

Anthracnose.—This attacks both leaves and fruit, producing black spots which may show smaller pink spots or patches. It has been reported as quite destructive in some parts of this state. Spraying with bordeaux mixture has been found quite effective in controlling it.

Downy Mildew or Blight.—This is a serious disease in many places, and may be recognized by the angular, brown, dead spots which are produced on the leaves. When badly spotted, the leaves dry up and die. The fruit from such vines is said to be of inferior quality, and frequently fails to ripen. The fungus causing this disease is the same one which causes the downy mildew of the cucumber. The bordeaux mixture has been found less effective in controlling this disease on muskmelons than on cucumbers. When the disease has appeared in a field, planting in new soil is sometimes advised.

Wilt.—This is a bacterial disease caused by the same

Fig. 1. Muskmelon vine destroyed by blight. After Clinton.

Fig. 2. Under surface of blighted muskmelon leaf, showing dead spots. After Clinton.

organism as the cucumber wilt. It seldom does any great amount of injury, and the best methods of control are to keep the vines free from beetles, dstroy all diseased plants, and plant on new soil the next year.

ONION.

Mildew, or Blight.—The fungus causing this disease produces gray spots on the leaves, and these enlarge until the entire leaf may be covered. It is sometimes quite destructive, especially upon young plants. After the disease has appeared in a field, onions should not be grown there for at least two years. Bordeaux mixture is quite effective in controlling this disease, but it must contain some adhesive (see formulae at close of article) to make it stick to the leaves.

Smut.—This may be recognized by the small black pustules which appear on the leaves, or sometimes on the bulbs. It is most often destructive on young seedlings. Formalin, diluted at the rate of 1 pint to 30 gallons of water, and applied to the seed just before covering, by means of a drip attachment on the seeder, has been found quite valuable in preventing this disease. One gallon of this solution is sufficient for about 400 feet of drill. A mixture of 50 pounds of lime and 100 pounds of sulphur applied in the drills is also a good preventive. This mixture should be applied at the rate of 150 pounds per acre.

PEA.

Mildew.—This produces a white coating on both sides of the leaves, and such leaves soon become yellow and die. It may be largely controlled by spraying with bordeaux mixture, but the amount of damage is not ordinarily great enough to warrant going to much expense for spraying.

Anthracnose.—This appears as small reddish spots on the leaves, pods, or stalks. It frequently causes a consider-

able amount of loss. Spraying with bordeaux mixture will generally help to prevent the disease.

POTATO.

Early Blight.—This is a very common and destructive disease, making its appearance during July. It produces brown spots on the leaves. These spots usually show well marked concentric circles. A poisoning due to strong insecticides sometimes causes a similar marking of the leaf, but, in such cases, the center of the spot is always an injury of some kind, frequently a flea-beetle puncture. The early blight spots are often so numerous that they unite causing the entire leaf to die. Bordeaux mixture has been found quite effective in controlling this disease.

Late Blight.—The late blight of the potato is sometimes though rarely found on the vine in July. It generally makes its appearance in August and does its greatest damage during the latter part of that month and early September. It, like the early blight, attacks the leaves at any point, but produces, instead of the concentric circles, an area which at first looks as though it had been injured with hot water. This scalded area later becomes yellow and dead. Near the edges of these spots on the under surface of the leaf there is a fine white growth. The same fungus which causes the death of the leaves causes a decay of the potatoes, so that fields which have been infected with the disease should have the potato tops kept from contact with the potatoes at the time of digging. Thorough spraying with bordeaux mixture is a reliable remedy for the disease.

Scab.—The scab spots produced on potatoes are too well known to require a description. The fungus causing this disease lives over from year to year in the soil, and is also carried over on tubers having scab spots. The only practical remedy is to use clean seed disinfected with formalin, used at the rate of 1 pint to 30 gallons of water, or with corrosive sublimate used at the rate of 4 ounces to 30 gallons of water, and

then to plant on clean soil. Land which has grown scabby potatoes should not be again used for growing potatoes for at least three years. There is no method of treatment known by which clean potatoes can be grown in soil infested with the scab. The fungus which causes the disease thrives best in a soil containing lime or ashes so that applications of these materials to soil where potatoes are to be grown should be avoided.

Fusarium Wilt.—This is a disease attacking the stems of the potato plant, causing them to wilt and die. The same fungus causes a dry rot of the tubers. The best methods of control for this disease are to avoid planting any diseased tubers, and to plant on fresh soil.

Bacterial Wilt.—This is a bacterial disease which causes the plant to wilt and die. A soft rot of the potatoes is caused by the same bacteria. It may be prevented by avoiding any seed tubers which show signs of the soft rot, destroying or driving away all beetles, and planting on soil which did not have a crop containing diseased plants the year before.

Leaf Blotch.—This may be recognized by the small slate colored spots which appear on the under side of the leaves during July and August. It has not been known to cause serious injury to a crop, and definite methods of control are not given.

RASPBERRY.

(See under Blackberry).

SQUASH.

The squash is subject to the same diseases as the cucumber, and their methods of control are the same.

STRAWBERRY.

Leaf Spot or Blight.—This appears on the leaves as white spots which have a purple border. The fungus passes the winter in dead leaves, so that all such should be removed from

the field and destroyed. Spraying with bordeaux mixture is also quite effective against it.

TOMATO.

Rust or Leaf Spot.—Tomato leaves affected with this show numerous small brown spots. The disease sometimes causes quite serious loss in the production of tomatoes, since affected leaves finally dry up and die, and the fruit from such vines is of inferior quality and size. The bordeaux mixture spray is the best known preventive for this disease.

Bacterial Blight or Wilt.—This is similar to the bacterial wilt of the Potato and the best methods of treatment are the destruction of biting insects, and growing plants on soil where the disease has not been present for 2 or 3 years.

Fungus Blight.—This disease causes the leaves to die beginning with the lower ones and continuing upward along the stock. The stem when cut across shows darkened veins. The fungus which causes the disease lives over in the soil from year to year, so that the best method of treatment is to keep infested soil free from tomatoes for at least 3 years after a crop showing the disease has been there.

TURNIP.

The diseases of turnip are practically the same as those of the cabbage and cauliflower, and the methods of treatment are similar. (See under cabbage).

WATERMELON

Anthracnose.—This may be recognized by the black spots which appear on the vines and fruits. The older spots may show small pink areas in them. The disease has been reported

PLATE V

Fig. 1. Sketch of potato leaf, showing spots produced by early blight fungus. After Jones.

Fig. 2. Photograph of potato leaves diseased with late blight. After Clinton.

as very destructive in some portions of this state. Spraying the vines with bordeaux mixture was found to greatly reduce the amount of injury.

Leaf Spot.—This disease may be distinguished from the anthracnose by the gray center in the spots. It does not attack the fruits. Thorough spraying with bordeaux mixture is recommended for its control.

FORMULAE

BORDEAUX MIXTURE

Copper sulphate	5 lbs.
Stone lime	5 lbs.
Water	50 gal.

For detailed instructions see front part of bulletin.

AMMONIACAL COPPER CARBONATE.

Copper carbonate	5 oz.
Ammonia	3 pints
Water	50 gal.

Dilute the ammonia in 7 or 8 parts of water. Make a paste of the copper carbonate with a little water. Add the paste to the diluted ammonia and stir until dissolved. Add enough water to make 50 gallons. The mixture should be made up fresh for it loses its strength on standing.

CORROSIVE SUBLIMATE

Corrosive sublimate	4 oz.
Water	30 gal.

It is best to dissolve the corrosive sublimate in 2 to 3 gallons of hot water and add this solution while hot to the

remainder of the water. This amount is sufficient to disinfect 25 to 30 bushels of potatoes for scab. Metal dishes must not be used for containing any corrosive sublimate solution.

FORMALIN.

Formalin ..... 1 pt.
Water ..... 30 gal.

This amount is sufficient for disinfecting about 20 bushels of potatoes for scab.

ADHESIVE MIXTURE

Sal soda ..... 1 lb.
Resin ..... 2 lbs.
Water ..... 1 gal.

Boil 1 to 1½ hours in an iron kettle. Add this amount to 50 gallons of bordeaux mixture for spraying onions, cabbage or other plants from which the regular bordeaux runs off too readily.